EUROPEAN CENTRAL BANK

EUROSYSTEM

TIPS – how it meets your needs

Focus Session – embracing instant payments

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Overview

1. Today
2. Performance
3. Availability and business continuity
4. Eco-sustainability
5. Technology
6. Openness
7. Tomorrow

1.

Today

What has TIPS achieved so far?

- Pan-European Reachability measures
- Interoperability framework across CSMs
- Onboarding framework for non-euro communities
- Sveriges Riksbank Currency Participation Agreement
- TIPS Resilience And Continuity Enhancement (RACE)
- Full integration of TIPS in TARGET Services with T2-T2S Consolidation go-live

How many countries asked us to present TIPS?

2.

Performance

How fast is TIPS?

- A lot of things can happen in **less than one second**:

A human brain to recognize a familiar song

Marcel Jacobs to run 10 m

TIPS to settle an IP

A heart to beat

The Earth to rotate 100 m

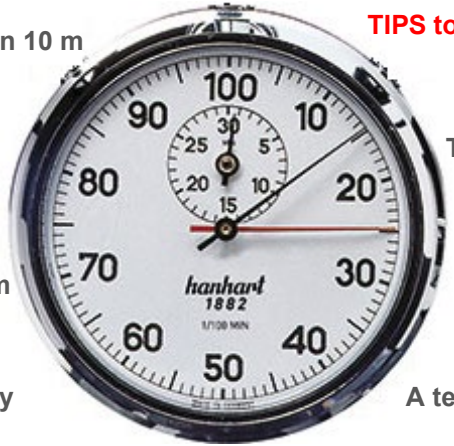
A cheetah to run 25 m

An eye to blink

A human being to say 'instant'

A tennis serve to touch the ground

A wiper to cross the windscreen



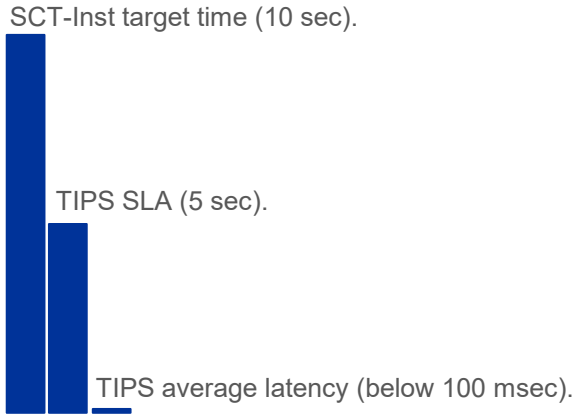


TABLE 1 - Comparing the average TIPS latency with the prescriptions of the Service Level Agreement and of the EPC instant payment scheme.

How fast is TIPS?

- Speed is one element, but also **throughput** matters

- Looking at payment statistics for 2021, TIPS may handle the **total number of non-cash payments** in the euro area

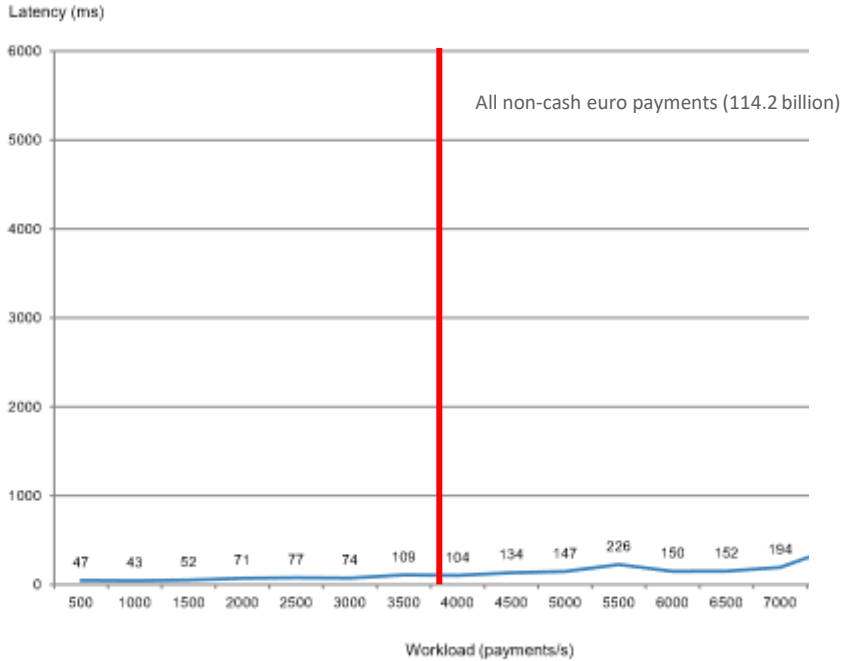


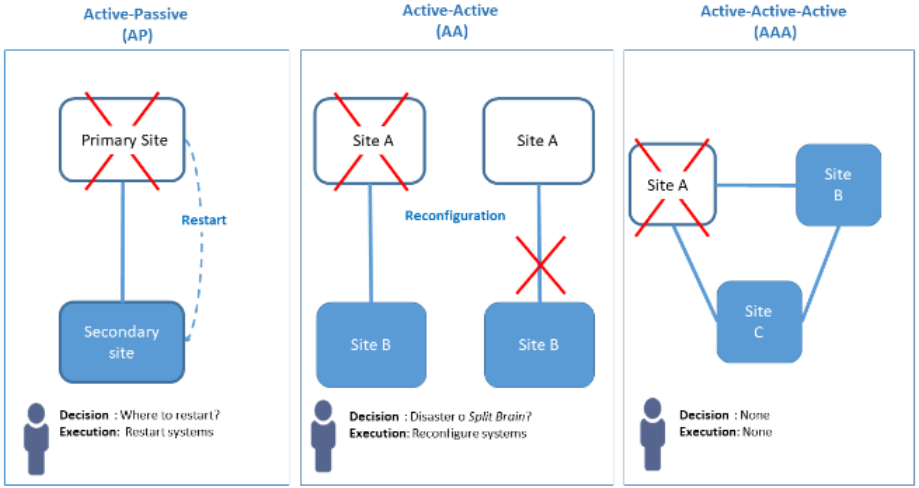
FIGURE 1 – Scalability curve – Latency by workload.

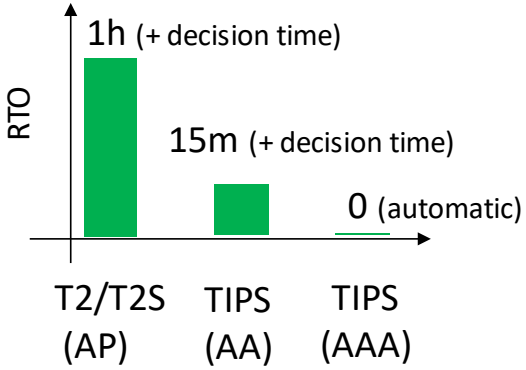
3.

Availability and business continuity

Availability and business continuity **in theory**

- TIPS relies on an **Active-Active-Active** business continuity model:





- This allows making the **decision process automatic** and lowering the Recovery Time Objective **(RTO) to zero**

Availability and business continuity **in theory**

- OK, when there is an incident and a data centre is lost, TIPS keeps on working. But at the end of the year, what will the total service downtime be?

- With the three-data-centres configuration the **total availability** of the TIPS settlement engine is **0.9999997**, which corresponds to an estimated service outage of about **10 seconds per year**

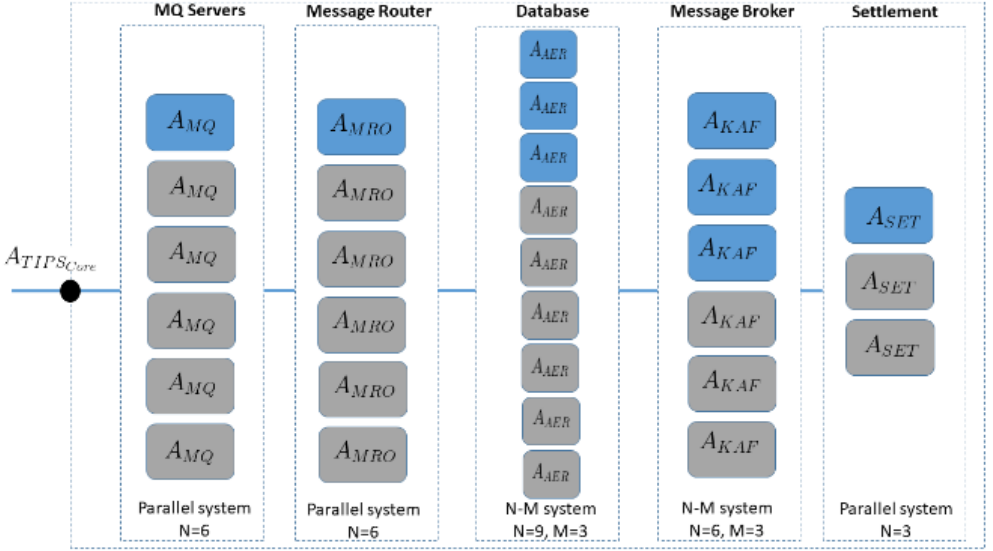
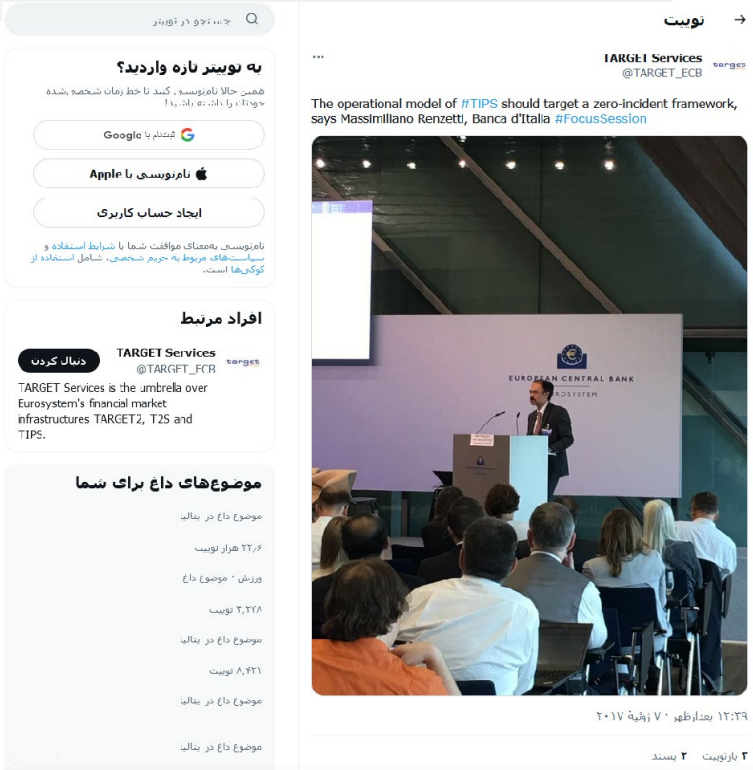


FIGURE 2 - Settlement engine availability model for the three data centres footprint (boxes highlighted in blue represent the minimal set of servers needed to provide the service)

Availability and business continuity **in practice**

- According to the TIPS SLA, the unplanned downtime, calculated on a quarterly basis, shall not exceed **2.16 hours**, equivalent to an availability of **99.9%**

- Since its go-live, on 30 November 2018, the TIPS settlement engine provided a **100% availability**, experiencing **zero downtime incidents**



4.

Eco-sustainability

Is TIPS really green?

Table 2. Average instantaneous power $\overline{P(t)}[W]$, absolute carbon footprint $CF[kgCO_2]$, total transactions N and CO_2e emissions per transaction ($CF^{Trx}[gCO_2]$) measured for TIPS in different trx/s scenarios: (A) TIPS in 2019; (B) Bitcoin in 2018; (C) Mature instant payments market (e.g. Sweden); (D) TIPS under normal load conditions.

	trx/sec.	$\overline{P(t)}$	CF_{TIPS}	N_{TIPS}	CF^{Trx}_{TIPS}
(A) TIPS in 2019	0.0025	14,648	64,928.4	$7.70 \cdot 10^4$	$8.43 \cdot 10^2$
(B) Bitcoin in 2018	4	14,994	66,461.8	$1.26 \cdot 10^8$	0.53
(C) Mature instant payments market	100	15,078	66,834.1	$3.15 \cdot 10^9$	$21.21 \cdot 10^{-3}$
(D) TIPS under normal load conditions	500	15,201	67,379.4	$15.7 \cdot 10^9$	$4.29 \cdot 10^{-3}$

Do you want TIPS to become even more eco-sustainable? Then you should **settle more transactions** in TIPS!

5.

Technology

Is TIPS state-of-the-art?

- One may say TIPS is a kind of **Turing machine** (Alan Turing, 1948)…

10. More precisely, TIPS settlement implements the following *deterministic finite state machine*, a system:

$$M = \{I, O, S, f, g\}$$

where:
$I = \{i_1, i_2, \ldots, i_n\}$ is the finite set of all the possible input symbols,
$O = \{o_1, o_2, \ldots, o_n\}$ is the finite set of all the possible output symbols,
$S = \{s_1, s_2, \ldots, s_n\}$ is the finite set of all the possible states,
$f : I \times S \rightarrow O$ is the function linking input values to output values,
$g : I \times S \rightarrow S$ is the transition function of system internal states.

Given an ordering, strict and total, defined on I and S, then for any element $\lambda \in \mathbb{N}\ (\lambda < n)$:

$$O(\lambda) = f(I(\lambda), S(\lambda)) \text{ and}$$
$$S(\lambda + 1) = g(I(\lambda), S(\lambda)).$$

So, both the internal status of M and its output depend solely on the input and previous status and they do not depend on any other condition, such as time.

Is TIPS state-of-the-art?

- … but the thing is that TIPS relies on a **streaming architecture**, inspired by the **Reactive manifesto** (2014)

Reactive manifesto

Responsive

Focus on providing **rapid** and consistent response times.

Resilient

The system stays responsive in the face of **failure**.

Elastic

The system stays responsive under **varying workload**.

Message-driven

The system relies on **asynchronous messages** communication that ensures loose coupling.

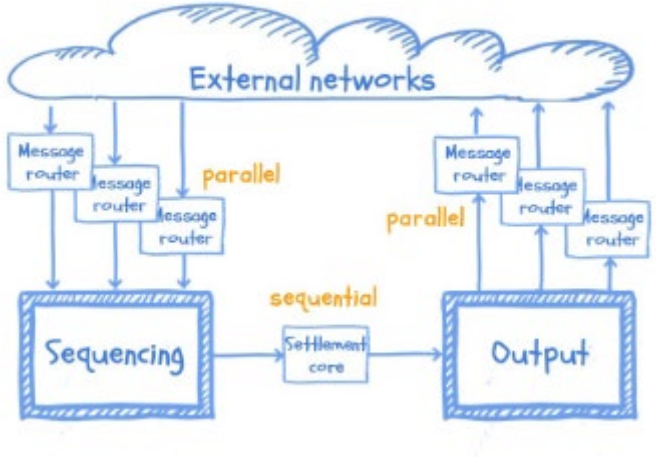


FIGURE 3 – TIPS architecture – Parallel and sequential streaming.

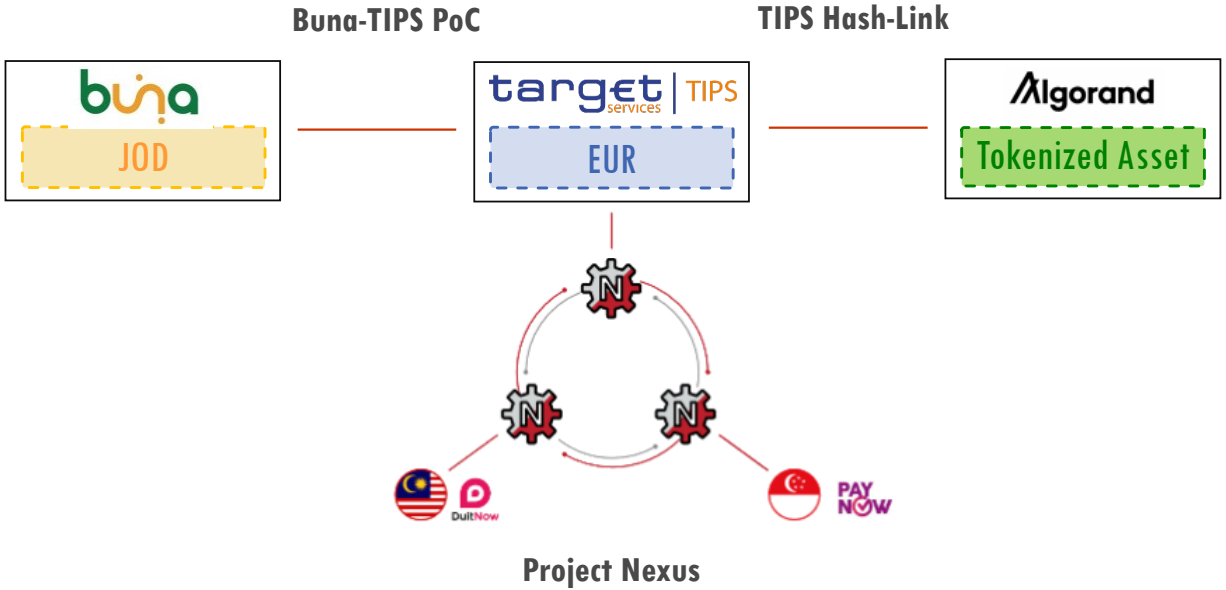
- By the way, Distributed Ledger Technologies were born with **Bitcoin in 2009**

6.

Openness

Does TIPS like talking to others?

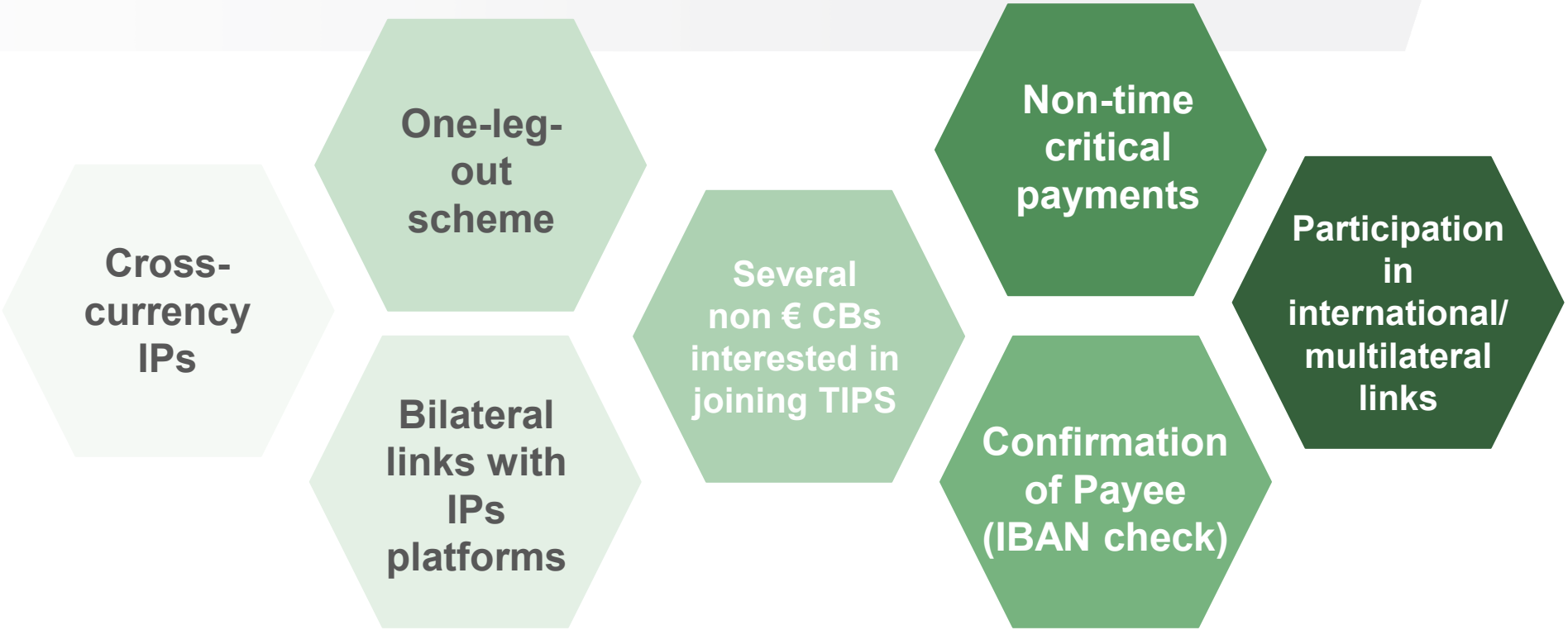
- When it comes to **cross-platform interoperability**, TIPS experimented on **bilateral and multilateral links** as well as on **integration with DLT platforms**…



7.

Tomorrow

What is coming for TIPS?



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